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(54) Metallized polypropylene films containing atactic and isotactic polypropylene

(57) Extrusion laminatable metallized oriented polymeric films, have an outer surface consisting of a mixture of isotactic polypropylene and a metal adhesion promoting amount of atactic polypropylene with a vacuum deposited metal layer on the said mixture. Good metal adhesion has been achieved combined with good metallic lustre following extrusion lamination. The mixture preferably contains not more than 30% by weight, e.g. 10-20% by weight, of atactic polypropylene and preferably has a melt flow index of less than 20 at 230°C. The metal deposited is preferably aluminium. The mixture is preferably itself present as a layer on a different polymeric layer, e.g. substantially isotactic polypropylene. A preformed polymeric film may be adhered onto the melted layer of the composite formed by co-extrusion using a melt of an ethylene/vinyl acetate copolymer, polyethylene or an ethylene/acrylate copolymer. This further pre-formed film may consist of a core of isotactic propylene with heat seal layers of a propylene/ethylene copolymer on either side.

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POLYMERIC FILMS

This invention concerns polymeric films and more particularly extrusion laminatable metallized polypropylene based films.

The ability to metallize polypropylene based films depends upon adhesion of the metal to the polymer of the film. If the adhesion to the polymer is insufficiently strong, metal is readily removed from the polymer, for example by handling of the film, leading to a deterioration in the properties of the film, for example reduced metallic lustre and/or reduced gas barrier properties.

The adhesion of vacuum deposited aluminium, for example, to isotactic polypropylene hompolymer is poor, even when the surface energy of the film has been increased by flame or corona discharge treatment.

It has been proposed hitherto to increase the adhesion of metal layers to such films by incorporating a propylene/ethylene copolymer into the surface of the films. Increasing the amount of copolymer in the film surface improves metal adhesion, but it lowers the melting and softening points of the film surface. This has the undesirable effect of leading to a deterioration in the metallic lustre of the metal layer when other polymeric films are laminated to the metal layer using a molten polyolefin, for example molten polyethylene. This is so-called extrusion lamination. Unfortunately, the amount of copolymer necessary to provide satisfactory metal adhesion is insufficient to prevent an unacceptable loss in metallic lustre on extrusion lamination.

European Patent Application 329336 makes an alternative proposed for improving the adhesion of vacuum deposited aluminium while reducing so-called "metal fracture", ie metallic lustre. In particular, flame treatment rather than corona discharge treatment is used to increase the surface energy of a semi-crystalline polypropylene. However, the amount and type of material present in the film surface giving rise to the semi-crystallinity is important. Thus it has been proposed in particular to use blends of at least 50 weight percent of substantially isotactic polypropylene with not more than 34 weight percent of a C_2 to C_4 polymer which promotes adhesion of metal to the surface layer and a second substantially isotactic homopolymer having a degree of atacticity of 6 to 15 percent. A specific Example of the use of an isotactic homopolymer having such an atactic content as the sole polymer of the film outer layer gave rise to a loss in metallic lustre. Another specific Example also illustrates the loss in metallic lustre caused by the low melting and softening points of ethylene/propylene copolymers when such metallized films are subjected to extrusion lamination.

According to the present invention there is provided an extrusion laminatable metallized oriented polymeric film having an outer surface comprising a mixture of isotactic polypropylene and a metal adhesion promoting amount of atactic polypropylene with a vacuum deposited metal layer on the said mixture.

Films in accordance with the present invention have shown good metal adhesion combined with good metallic lustre following extrusion lamination. Furthermore, these good properties can be achieved without the necessity for the use of a flame to enhance the adhesion of the metal to the surface of the film.

Excessively large amounts of atactic polypropylene in the mixture forming the outer surface of the film will reduce the melting point of the surface, thereby leading to a deterioration of the metallic lustre of the metal layer when a polymer layer is melt extruded onto the metal layer. If the amount of atactic polypropylene mixture forming the outer surface of the film is too low, adhesion of the vacuum deposited metal will be poor. In general, the amount of atactic polypropylene in the mixture will usually be not more than 30 percent by weight. However, the amount of atactic polypropylene will usually be at least 5 percent by weight of the mixture. A preferred range of atactic polypropylene content is from 10 to 20 percent by weight, 12 to 16 percent by weight being specially preferred. Within these preferred ranges, good metal adhesion can be achieved combined with good metallic lustre following extrusion lamination.

The mixture of atactic and isotactic polypropylene preferably has a melt flow index of less than 20 at 230°C as measured by ASTM as this generally reduces shrinkage of the mixture during extrusion lamination.

The mixture of atactic and isotactic polypropylene can be produced by known methods, for example blending with high shear.

It is generally preferred that the mixture of atactic and isotactic polypropylene having the vacuum deposited metal layer thereon is itself present as a layer on a different polymeric layer, for example substantially isotactic polypropylene, which acts as a support for the mixture.

Films in accordance with the present invention can be produced using known methods. In a preferred method, a layer of substantially isotactic polypropylene and a layer of the metal adhesion promoting polymer mixture are coextruded to form a polymer web which is then oriented, preferably biaxially. Biaxial orientation can be effected by stretching the polymer web sequentially, first in the direction of extrusion, for example using heated rollers, and then in the transverse direction using a stenter oven.

Metallization of the adhesion promoting polymer mixture can be effected by known methods, preferably using a vacuum technique. The surface of the adhesion promoting mixture will usually be subjected to a treatment to increase its surface energy, for example corona discharge treatment, before metallization is effected.

The surface of films of the invention not having the metal layer thereon preferably has an outer, heat-sealable layer thereon, for example of a copolymer of propylene with at least one of ethylene and but-1-ene. Such heat-sealable layers can be formed by known methods, for example by coextrusion with other polymer layers of the film.

The thickness of films in accordance with the present invention will usually be from 15 to 50 microns, the metal

adhesion promoting polymeric layer, and the heat seal layer when present, usually being from 0.8 to 2 microns thick.

Extrusion lamination can be effected using known methods. Typically such lamination will be effected using a melt of a suitable polymer, for example an ethylene vinyl acetate copolymer, polyethylene or an ethylene/acrylate copolymer, to form an extruded polymer layer on the metal layer which adheres another preformed polymeric film to a film of the present invention. The temperature of the polymer used to effect this lamination will typically be about 300°C, but it should be such that the film of the present invention does not shrink to an unacceptable extent and especially so that it adversely affects the appearance of the metal layer.

Various films can be laminated to films of the present invention using such a technique, for example biaxially oriented films consisting of a voided or non-voided polypropylene hompolymer core with a heat seal layer on each surface of the core, the heat seal layer being of a copolymer of propylene with units derived from at least one of ethylene and but-1-ene.

The following Examples are given by way of illustration only.

Example 1

A layer of substantially isotactic propylene homopolymer was coextruded with a layer of propylene homopolymer having an atactic content of 16 percent by weight, the remainder being isotactic polypropylene, to form a polymer web which was first stretched in the direction of extrusion and then in the transverse direction using a stenter oven. The surface of the film containing the atactic polypropylene was corona discharge treated and then wound up into a roll. The film

was 18 microns thick, the layer containing the atactic polypropylene was 1 micron thick.

Subsequently aluminium was deposited under vacuum to the surface of the film containing the atactic polypropylene.

Adhesion of the vacuum deposited metal to the polymeric film was tested using a conventional adhesive tape test, no metal being removed.

A further polymeric film 30 microns thick and consisting of a core of essentially isotactic polypropylene with heat seal layers 1 micron thick on either side and consisting of a propylene/ethylene copolymer including 4 percent by weight of units derived from ethylene was extrusion laminated to the metallized film using molten polyethylene at a temperature of about 300°C, the molten polyethylene being applied to the metal layer. The laminate was passed between rollers to promote adhesion between the layers of the laminate.

The resulting laminate showed a good metallic lustre.

<u>Example 2</u>

A metallized film was produced in a similar manner to that described in Example 1, but with the layer of propylene homopolymer containing atactic polypropylene having an atactic content of 8 percent with the remainder being essentially isotactic polypropylene.

About 10 to 20 percent of the aluminium was removed in the adhesive tape test, and good metallic lustre was observed following extrusion lamination as described in Example 1.

Example 3 (Comparison)

A metallized film was produced in a similar manner to that described in Example 1, but using a mono-web of isotactic polypropylene.

About 65 to 80 percent of the aluminium was removed in the adhesive tape test. Good metallic lustre was observed following extrusion lamination as described in Example 1.

Example 4 (Comparison)

A metallized film was produced in a similar manner to that described in Example 1, the layer containing atactic polypropylene being replaced by a layer of a propylene/ethylene copolymer containing 4 percent by weight of units derived from ethylene.

No metal was removed in the adhesive tape test, but the metal had a dull and crazed appearance following extrusion lamination as described in Example 1.

Claims

1. An extrusion laminatable metallized oriented polymeric film having an outer surface comprising a mixture of isotactic polypropylene and a metal adhesion promoting amount of atactic polypropylene with a vacuum deposited metal layer on the said mixture.

2. A film according to claim 1, wherein the said mixture contains not more than 30 percent by weight of atactic polypropylene.

3. A film according to claim 1 or claim 2, wherein the said mixture contains from 10 to 20 percent by weight of atactic polypropylene.

4. A film according to any of the preceding claims, wherein the said mixture contains from 12 to 16 percent by weight of atactic polypropylene.

5. A film according to any of the preceding claims, wherein the said outer surface is defined by a polymer having a melt flow index of less than 230°C as measured by ASTM.

6. A film according to any of the preceding claims, wherein the said outer surface is defined by a relatively thin polymeric layer on a relatively thick polymeric layer.

7. A film according to claim 6, wherein the relatively thick polymeric layer comprises substantially isotactic polypropylene.

8. A film according to any of the preceding claims, wherein the vacuum deposited metal layer comprises

aluminium.

9. A film according to any of the preceding claims, which has been extrusion laminated to a polymeric film.

10. A film according to claim 1, wherein extrusion lamination is to a film comprising oriented polypropylene.

11. A film according to claim 9 or claim 10, wherein lamination is effected by polyethylene or an ethylene/vinyl acetate copolymer.

12. A film according to any of the preceding claims, wherein the other outer surface of the film comprises a layer of a heat sealable polymeric material.

13. A method of producing an extrusion laminatable polymeric film, the method comprising producing a polymeric film having an outer surface comprising a mixture of isotactic polypropylene and a metal adhesion promoting amount of atactic polypropylene, subjecting the said outer surface to vacuum metallization whereby a metal layer is deposited thereon.

14. A method according to claim 13, wherein the film is subsequently laminated to a polymeric film by extrusion lamination.

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